

CHAPTER 5

STARTUP AND ALIGNMENT

LESSON PLAN 5

METHOD:

Conference, demonstration, and practical exercise

TIME ALLOTTED:

3.0 hours

COURSE PRESENTED TO:

- a. Tank crews
- b. Instructors
- c. TSC personnel

TOOLS, EQUIPMENT, AND MATERIALS:

See Appendix A

PERSONNEL:

- a. Primary instructor
- b. Assistant instructor

INSTRUCTIONAL AIDS:

- a. Overhead projector
- b. Viewgraphs (Appendix E)

REFERENCES:

- a. TM 9-6920-709-12&P-1-1, Chapter 2
- b. TM 9-6920-711-12&P-1
- c. TM 9-2350-255-10-1/2
- d. TM 9-2350-264-10-1/2

APPENDICES:

Appendix A. Tools, Equipment, and Materials
Appendix B. Safety
Appendix C. TDRS Memory Card Setup
Appendix D. Test Administration Guide
Appendix E. Viewgraphs

5-1. INTRODUCTION.

(5 minutes)

Note. Show Slide 1.

- a. **Reason.** To achieve realistic and effective training with TWGSS, tank crews must be able to correctly start, align, and verify alignment of TWGSS to the tank's fire control system (FCS).

Note. Show Slide 2.

- b. **Training Objective.** Given an operational M1/M1A1 tank with TWGSS installed, prepare-to-fire checks and boresighting completed, the crew will perform the following tasks:
 - (1) Conduct system startup IAW TM 9-6920-709-12&P-1-1, Chapter 2, in preparation for alignment.
 - (2) Conduct system alignment IAW TM 9-6920-709-12&P-1-1, Chapter 2, in preparation for training.
 - (3) Perform alignment verification of the TWGSS system.
- c. **Procedure.** During this block of instruction we will cover the startup and alignment of TWGSS in preparation for gunnery training. You will have an assistant (small group) instructor for the practical exercise portion of this lesson. After completion of training, you will be evaluated on your ability to align the TWGSS to the tank. You will use the appropriate TMs to align TWGSS.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE. (160 minutes)

- Notes.
- 1. The primary instructor will release the student crews to their assigned assistant (small group) instructors for the practical exercise portion of this lesson.
 - 2. Show Slide 3.

- a. **Control Panel.** The control panel is the crew interface with TWGSS during training.

- (1) **Control panel features.**
 - (a) Display screen for numerical and graphical presentation of results and information
 - (b) Four pushbuttons to interface/communicate with the system
 - (c) Slot for TDRS memory card
 - (d) Eject button for removal of memory card
 - (e) Fixed cable for connection to the system

Note. Show Slide 4.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

(2) Control panel functions.

- (a) Monitor and upload of ammunition. During training, ammunition can be monitored and uploaded (from semi-ready rack to ready rack) by crew using the control panel.
- (b) Result presentation. Firing results or target vehicle results can be presented to the crew either in numerical or graphic form.
- (c) System alignment. TWGSS is aligned by the crew prior to training using the control panel.
- (d) BIT and error presentation. When an error occurs, the control panel presents a pop-up screen with the error listed. The control panel also allows the crew to manually initiate BIT.
- (e) Controller functions. The control panel allows the instructor, using a CGUN, to upload ammunition, set time, etc. during training without the use of the TDRS computer unit.
- (f) Data storage. The TDRS memory card in the control panel contains firing and target vehicle application data and exercise events collected during training. The stored training exercise events can be retrieved for AAR with the TDRS computer unit.

Note. Show Slide 5.

- (3) **Control panel menus.** The control panel display screen is divided into several areas which have different functions.

F = Main function modes
SF = Sub-function of selected main function mode
T = Text area
S = Selection

Note. Show Slides 6 and 7.

(4) Pushbutton functions.

- (a) ENTER pushbutton.
 - 1. Gives access to menus highlighted by cursor
 - 2. Saves/accepts data
- (b) ESC pushbutton.
 - 1. Aborts menu
 - 2. Inhibits function or selection without saving data

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

(c) DOWN/LEFT pushbutton.

1. Moves cursor down or left in menus
2. Decreases values for data selected

(d) UP/RIGHT pushbutton.

1. Moves cursor up or right in menus
2. Increases values for data selected

Note. If a pushbutton is continuously pressed, a function will be repeated until pushbutton is released.

- b. **Startup and Alignment.** This is the most important step in preparing TWGSS for operation. Many factors can be induced that will degrade performance and produce incorrect training results.

Note. Show Slide 8.

(1) **System startup.** Startup of TWGSS is performed as follows:

- (a) Set gun/turret drive (GTD) switch to MANUAL.
- (b) Switch on master power of the tank.
- (c) Switch on turret power.
- (d) Check that FCS malfunction is not indicated on commander's panel.
- (e) Switch on utility switch on the TNB. Power is applied to TWGSS.

Note. Show Slide 9.

(2) **Built-in test (BIT).** A built-in test is automatically performed when the system is powered up. If there is an error within the system, it will be announced with the following indications:

- (a) Pop-up screen on the control panel
- (b) Sound indication on tank intercom
- (c) Visual indications in retro detector units

Note. Show Slide 10.

(3) **System error.** If a system error appears do the following:

- (a) Consult TM 9-6920-709-12&P-1-1, Chapter 3, for troubleshooting procedure based upon the BIT indication provided on the control panel.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

Warning. Ensure that vehicle master power switch is in OFF position before connecting or disconnecting cables. Main gun/turret could move suddenly and injure personnel.

- (b) Do not connect or disconnect TWGSS cables with vehicle master power switch in ON position.

Note. Show Slide 11.

(4) **Alignment.**

- (a) Alignment is the process during which TWGSS is aligned to the tank's FCS. This is done electrically/optically with the FCS set to a predetermined value.

Note. Show Slide 12.

- (b) The following conditions are used during alignment of TWGSS:
 - 1. A boresighted and operational tank with TWGSS installed
 - 2. 1200 m entered into FCS and boresight pressed on computer control panel (CCP)
 - 3. Reticle aiming point of gunner's primary sight (GPS)
 - 4. Boresight cross of gunner's auxiliary sight (GAS)

Note. Show Slide 13.

- (c) TWGSS alignments must be performed in the following order:
 - 1. **Cant alignment.** Adjustment of the transceiver unit to match the actual cant of the tank
 - 2. **Laser alignment.** Alignment of the transceiver unit to tank's sight system
 - 3. **TBOS GAS.** Alignment of the TBOS effects into the GAS
 - 4. **TBOS GPS day mode.** Alignment of the TBOS effects into the day mode of the GPS
 - 5. **TBOS GPS thermal mode.** Alignment of the TBOS effects into the thermal mode of the GPS
 - 6. **Turret position sensor (TPS) alignment.** Alignment of the turret and hull relation as sensed by the TPS.

Notes. 1. The primary instructor now releases the student crews to their assigned assistant (small group) instructors for the practical exercise portion of this lesson.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

2. Prior to students' arrival, ensure that an assistant instructor is assigned to each training station.
3. Direct students to their appropriate training station.
4. Each assistant instructor is to conduct a safety briefing for his small group IAW Appendix B.
5. Whenever possible, have the students serve as demonstrators during small group instructions. Have one student read the procedures while another student performs the task. To ensure all students get equal hands-on time, rotate the reading and performance responsibilities.
6. The assistant instructor discusses and clarifies the procedures as required and reinforces the training objective.
7. Before switching TWGSS on, verify that each crew has a memory card set up IAW Appendix C.

c. Preparation Prior to Alignment.

- (1) Place a boresight panel equipped with a retro reflector unit as close to 1200 m as possible.
- (2) Position tank on level ground.

d. Startup Procedure. TWGSS starts automatically when power is applied.

(1) Power on.

- (a) Set gun/turret drive (GTD) switch to MANUAL.
- (b) Switch on master power of tank.
- (c) Switch on turret power.
- (d) Check that FCS malfunctions are not indicated on commander's panel.
- (e) Switch on TNB utility switch (simulator is powered up).

(2) Built-in test (BIT).

- (a) When the power is applied, an automatic BIT is performed. If an error is found, the intercom announces this and an error message is found on the control panel.

Note. If an error is discovered during the startup procedure, perform troubleshooting IAW Chapter 3 of TM 9-6920-709-12&P-1-1.

Warning. Ensure that vehicle master power switch and turret power switch are in the OFF position when corrective actions are performed. Damage could occur to components and/or tank or personnel could be injured if cables are connected/disconnected with power switched on.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

- (b) BIT is automatically performed when the simulator is powered up. BIT is conducted continuously until power is switched off at the TNB utility switch.
 - (c) After completion of a successful BIT, data from the TDRS memory card is downloaded into the system. A pop-up screen informs the operator when data is being downloaded.
- e. **Setup of Control Panel.** The control panel display screen can be adjusted for different light conditions. To adjust, select the main function SU with up or down arrows and press ENTER.
 - (1) **Backlight adjustment.** Select BL and press ENTER. Use left or right arrows to switch backlight on or off. Save setting with ENTER.
 - (2) **Contrast adjustment.** Select CO and press ENTER. Use left or right arrows to increase or decrease contrast of display. Save setting with ENTER.
- f. **Tank Setup During Alignment.** When AL is selected, pop-up screens with detailed instructions are presented to help the crew setup the tank correctly.

Note. The tank settings must be used during all steps of TWGSS alignment.

- (1) Open CCP door and switch on CCP power.
 - (2) Select AL on control panel and press ENTER. Follow instructions.
 - (3) Place gun select switch to MAIN.
 - (4) Set fire control mode switch to MANUAL.
 - (5) Set GPS magnification lever to 10X.
 - (6) Press ENTER on control panel. A new pop-up screen is presented.
 - (7) Enter 1200 m into FCS.
 - (8) Select SABOT.
 - (9) Press ENTER on control panel. A new pop-up screen is presented.
 - (10) Grasp and release palm switch. A 1200 m solution is entered into FCS.
 - (11) Press ENTER on control panel. The alignment menus are now accessible and the tank is set up correctly for the alignment.
- g. **System Alignment.** Alignment procedures are performed in the order presented on the control panel.

- Notes.
- 1. Set thermal mode switch to STAND BY.
 - 2. Alignment **MUST** be performed in strict accordance with instructions provided to ensure correct training results.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

- (1) **Cant alignment.** Cant alignment aligns the cant of the transceiver unit positioned in the gun tube with the cant of the tank.
 - (a) Press CANT button on CCP. Actual tank cant is displayed.
 - (b) Arm weapon.
 - (c) Select CA (cant alignment) on control panel. The menu indicates cant angle of transceiver unit.
 - (d) Have crewmember unlock locking handle of transceiver unit and turn until indicated angle of transceiver unit is equal to that of tank. Values must be within 0.2° .
 - (e) Have crewmember lock locking handle of transceiver unit.
 - (f) Exit menu with ESC.
 - (g) Cancel CANT on CCP.
- (2) **Laser alignment.** Laser alignment aligns the tank line of sight with that of the transceiver unit. Alignment of the transceiver unit must be performed with 1200 m manually indexed into the FCS and boresight button pressed on the CCP.

- Notes.
1. Ensure only one retro reflector unit is visible. If more than one retro reflector unit is visible during laser alignment, it could cause incorrect alignment.
 2. Alignment can be performed from 200 to 4000 m, but 1200 m is the preferred range.
 - (a) Using manual controls, lay GPS aiming point on center of retro reflector unit.

Note. During this step the gunner aims at the actual retro reflector unit, not the center of the panel target.

- (b) Select LA (laser alignment) on control panel.

Note. Boresight must be pressed for ALL remaining alignments.

- (c) Press boresight on CCP.
- (d) Select RE (Reset) and press ENTER to reset old laser alignment values.
- (e) Select M (Measure) and press ENTER on control panel. This activates the first laser alignment measurement.
- (f) Press ENTER button a minimum of 3 times to allow TWGSS to calculate an average value of the alignment measurements.
- (g) Save alignment by selecting S (Save) and press ENTER.
- (h) Press ESC.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

(3) **TBOS GAS alignment.** This is the alignment of the visual effect for the GAS.

Note. Demonstrate to all students the position of a correctly aligned TBOS reticle in the GAS.

- (a) Look through GAS.
- (b) Select a target with a dark background to allow for better observation of TBOS effects.
- (c) Select GA (GAS alignment) on control panel.
- (d) Select R (Reset) and press ENTER to remove old alignment values.
- (e) Select AL (align TBOS) and press ENTER to start.
- (f) Perform rotation alignment. Rotate cross until aligned with reticle using up/down arrows. The cross is properly positioned when horizontal and azimuth lines of sight and cross are parallel and center line of cross is pointing at bottom of sight.
- (g) Press ENTER to continue.
- (h) Perform elevation alignment. Using up/down arrows, adjust dot until level with GAS boresight cross.
- (i) Press ENTER to continue.
- (j) Perform azimuth alignment. Adjust dot until positioned on top of the GAS boresight cross.
- (k) Press ENTER to save.

Note. After ENTER is pressed, the TBOS alignment vehicle is displayed. If not properly aligned with sight reticle, repeat steps (d) through (k).

- (l) Exit menu by pressing ESC.

(4) **TBOS GPS day alignment.** This is the alignment of the visual effect for the GPS day channel.

- (a) Look through GPS.
- (b) Select GD (GPS day alignment) on control panel.
- (c) Set GPS to CLEAR.
- (d) Set TIS to STNBY.
- (e) Select RE (Reset) and press ENTER to remove old alignment values.
- (f) Select AL (align TBOS) and press ENTER to start.

Note. Rotation is not performed for GPS TBOS effects.

- (g) Perform elevation alignment. Using up/down arrows, adjust dot until level with aiming point of reticle.
- (h) Press ENTER to continue.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

- (i) Perform azimuth alignment. Adjust dot until positioned on top of aiming point of reticle.
- (j) Press ENTER to save.

Note. After ENTER is pressed, the TBOS alignment dot is displayed. If not properly aligned, repeat steps (e) through (j).

- (k) Save and exit menu by pressing ESC.

(5) **TBOS GPS thermal alignment.** This is the alignment of the visual effect for the GPS thermal channel.

- (a) Look through GPS.
- (b) Select GT (GPS thermal alignment) on control panel.
- (c) Set GPS to SHUTTER and TIS to ON. Adjust thermal picture.
- (d) Select RE (Reset) and press ENTER to remove old alignment values.
- (e) Select AL (align TBOS) and press ENTER to start.

Note. Rotation is not performed for GPS TBOS effects.

- (f) Perform elevation alignment. Using up/down arrows, adjust dot until level with aiming point of reticle.
- (g) Press ENTER to continue.
- (h) Perform azimuth alignment. Adjust dot until positioned on aiming point of reticle.
- (i) Press ENTER to save.

Note. After ENTER is pressed, the align TBOS screen is displayed. If further adjustment is required, repeat steps (d) through (i).

- (j) Exit menu by pressing ESC.

(6) **TPS alignment.** This aligns the turret and hull relationship monitored by the TPS.

- (a) Position main gun at 12 o'clock, centered between two headlights.
- (b) Select TP (turret position sensor alignment). Press ENTER.

Note. At this time press ENTER on CCP to enter boresight data and turn CCP OFF.

- h. **Alignment Verification.** After completing TWGSS alignment procedures, verify that the alignment is correct.

5-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

- (1) **Verification SABOT.** Fire a SABOT round at the retro reflector unit used for alignment. Verify that TBOS effects and hit result are correct.
- (2) **Verification HEAT.** Fire a HEAT round at the retro reflector unit used for alignment. Verify that TBOS effects and hit result are correct.

Note. To register a HIT with coax, use a target positioned within 900 m of the tank.

- (3) **Verification COAX.** Fire coax rounds at the retro reflector unit. Verify that TBOS effects and hit result are correct.

5-3. TEST. (15 minutes/test)

Note. See Appendix D.

5-4. FINAL REVIEW. (5 minutes)

- a. **Student Questions.**

Note. Show Slide 14.

- b. **Summary of Main Teaching Points.**

- (1) Startup procedures
- (2) System alignment
- (3) Alignment verification

Note. Show Slide 15.

- c. **Closing Statement.** To achieve the desired training result with TWGSS, you must be able to correctly conduct startup, system alignment, and alignment verification of TWGSS to the tank FCS.

APPENDIX A TO LESSON PLAN 5

STARTUP AND ALIGNMENT

TOOLS, EQUIPMENT, AND MATERIALS

Listed equipment is one per tank crew, except as noted.

1. M1/M1A1 tank with TWGSS installed
2. TM 9-6920-709-12&P-1-1
3. Boresight panel with retro reflector unit (one per class)
4. TDRS memory card programmed IAW Appendix C
5. TDRS computer unit (one per class)
6. Training area with a minimum of 1200 m of maneuver space

APPENDIX B TO LESSON PLAN 5

STARTUP AND ALIGNMENT

SAFETY

Listed general safety regulations are to be strictly enforced during the performance of this lesson.

1. Mount and dismount tank over left front fender.
2. Maintain three points of contact while on top of tank.
3. No smoking within 50 m of tank.
4. Do not go over or under gun tube.
5. Ensure LRF has eye-safe laser filter (ELF) installed and LRF is set to SAFE.
6. LASER SAFETY: Do not view transceiver unit with optics from a distance of 25 m or closer.
7. Ensure proper hearing protection is worn when using pyrotechnics.
8. When using pyrotechnics (Hoffman device), ensure area is clear 50 m to the front and 25 m to the sides.
9. Ensure gun/turret drive (GTD) switch is set to MANUAL position during installation/removal, alignment, troubleshooting, and before leaving the turret.
10. Ensure vehicle master power switch is in OFF position before connecting or disconnecting TWGSS cables.
11. No cables should be connected or disconnected by untrained personnel.
12. Extra care should be taken when power is switched on after TWGSS installation. This is to ensure integration to FCS is correct and secure.

APPENDIX C TO LESSON PLAN 5

STARTUP AND ALIGNMENT

TDRS MEMORY CARD SETUP

The TDRS memory card used for the practical exercise (PE) part of this lesson has been set up with the following data. Each crew is given a card prior to the PE portion of class.

Application:	M1/M1IP	M1A1
Exercise Area:	Select exercise area used	Select exercise area used
New Ammo:	Yes	Yes
First Insert Only:	No	No
<u>Main Weapon:</u>		
SABOT Turret:	16 rounds	11 rounds
HEAT Turret:	9 rounds	6 rounds
SABOT Hull:	18 rounds	15 rounds
HEAT Hull:	12 rounds	8 rounds
Load Time:	6 seconds	6 seconds
Upload Time:	60 seconds	60 seconds
<u>COAX Rounds:</u>		
7.62 Turret:	11400 rounds	11400 rounds
7.62 Hull:	0 rounds	0 rounds
Upload Time:	- seconds	- seconds
Exercise type:	Panel gunnery	Panel gunnery
<u>Tracer:</u>		
Tracer On:	Yes	Yes
Burst On:	Yes	Yes
Obscuration:	Yes	Yes
<u>Presentation:</u>		
Audio:	Yes	Yes
Control Panel Presentation:	Yes	Yes
Firing:	Full scale	Full scale
Dispersion:	No	No
User Data:	Input crew data	Input crew data

APPENDIX D TO LESSON PLAN 5

STARTUP AND ALIGNMENT

TEST ADMINISTRATION GUIDE

D-1. TASK.

Administer test, *Alignment of TWGSS*.

D-2. CONDITIONS.

Given a fully operational M1/M1A1 tank with BII and TWGSS installed

D-3. STANDARDS.

The crewman will correctly align TWGSS to the tank within 10 minutes

D-4. PERSONNEL, EQUIPMENT, AND MATERIAL REQUIRED.

- a. Evaluator (one per test station)
- b. M1/M1A1 tank with BII and TWGSS installed (one per test station)
- c. Boresight panel at 1200 m with retro reflector unit installed
- d. TM 9-2350-255-10-1/2 or TM 9-2350-264-10-1/2 (one set per test station)
- e. TM 9-6920-709-12&P-1-1 (one copy per test station)
- f. Scoring checklist of Appendix D (one copy for each crewman tested)

D-5. TEST PLANNING TIME.

Administrative time:	5 minutes
Test time:	<u>10 minutes</u>
TOTAL TIME (per crewman):	15 minutes

D-6. OTHER INFORMATION.

Before the crewman arrives, the evaluator will:

- a. Position a boresight panel with a retro reflector unit at a distance of 1200 m
- b. Ensure TM 9-2350-255-10-1/2 or TM 9-2350-264-10-1/2 is available
- c. Ensure TM 9-6920-709-12&P-1-1 is available
- d. RESET all TWGSS alignment values prior to arrival of each crewman
- e. Ensure TIS is cooled down and ready light is indicating OK
- f. Have scoring checklist ready for crewman to be tested

D-7. INSTRUCTIONS TO STUDENT.

"The purpose of this test is to determine your ability to correctly align the TWGSS to the M1/M1A1 tank. You will have 10 minutes to complete all steps. You must complete each step before beginning the next step. Your time will start when I announce 'BEGIN' and end when you announce 'FINISHED'. You may use TM 9-6920-709-12&P-1-1 during the test".

"Do you understand the requirements of this test?" (Answer questions)

"You may begin." (Start time)

ALIGNMENT OF TWGSS

Scoring Checklist

NAME _____ UNIT _____

GRADE _____ DUTY POSITION _____

	GO	NO GO
1. Safety precautions prior to alignment	_____	_____
a. Verify that eye-safe laser filter is installed	_____	_____
b. Set GTD switch to MANUAL	_____	_____
c. Check for FCS malfunctions on commander's panel	_____	_____
2. Tank setup when selecting alignment menu		
a. Gun select switch set to MAIN	_____	_____
b. Fire control mode set to MANUAL	_____	_____
c. GPS set to 10X magnification	_____	_____
d. 1200 m entered into FCS	_____	_____
e. SABOT selected	_____	_____
f. Gunner's palm switch pressed and released	_____	_____
3. Cant alignment procedure		
a. Cant on CCP and cant on control panel matched within $\pm 0.2^\circ$	_____	_____
b. Transceiver unit handle locked after completed alignment	_____	_____
4. Laser alignment		
a. Boresight button pressed	_____	_____

	GO	NO GO
b. Aiming point positioned on retro reflector unit	_____	_____
c. Minimum of 3 alignment measurements executed	_____	_____
d. Save correctly performed	_____	_____
5. TBOS GAS alignment		
a. Cross properly aligned within field of view	_____	_____
b. Dot positioned in elevation on horizontal boresight line	_____	_____
c. Dot positioned on boresight mark	_____	_____
6. TBOS GPS day alignment		
a. TIS set to STNBY	_____	_____
b. Filter/Shutter/Clear set to CLEAR	_____	_____
c. Dot positioned on aiming point	_____	_____
7. TBOS GPS thermal alignment		
a. TIS set to ON	_____	_____
b. Filter/Shutter/Clear set to SHUTTER	_____	_____
c. Dot positioned on aiming point	_____	_____
8. TPS alignment		
a. Main gun centered correctly between headlights	_____	_____
b. Alignment stored correctly	_____	_____

	GO	NO GO	INITIALS
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Crewman satisfactorily completed all requirements	_____	_____	_____
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EVALUATOR _____	DATE TESTED _____
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REMARKS _____

**APPENDIX E
TO LESSON PLAN 5
STARTUP AND ALIGNMENT
VIEWGRAPHS**
